

What is claimed is:

1. A stator coil including sequentially-connected conductor segments for an electric rotary machine, comprising:
  - 5        a plurality of conductor segments accommodated in a slot of a stator core having an even number of conductor accommodation positions serially aligned in the radial direction, said conductor segments being sequentially connected to cooperatively constitute one turn of a phase coil of an M-phase (M is an integer not smaller than 3) armature coil,
  - 10      each of said conductor segments having a pair of in-slot conductor portions separately accommodated into the conductor accommodation positions of two different slots mutually spaced by substantially one pole pitch, a head conductor portion continuously extending from said in-slot conductor portions and protruding from one end of said stator core so as to constitute a head side coil end, and a pair of tail conductor portions continuously extending from said in-slot conductor portions and protruding from the other end of said stator so as to constitute a tail side coil end,
    - 15      said head conductor portion having a U-shaped head top portion, and a pair of head slanting portions extending obliquely in both circumferential and axial directions from said head top portion and respectively connected to said in-slot conductor portions,
    - 20      said tail conductor portions having a pair of tail slanting portions extending obliquely in both circumferential and axial directions from said pair of in-slot conductor portions, and tail joint portions formed at distal ends of said tail slanting portions and bonded to tail conductor portions of other conductor segment,
  - 25      said head side coil end including a plurality of said head conductor portions serially disposed in the radial direction when seen from the circumferential direction, and
  - 30      said tail side coil end including a plurality of said tail conductor portions serially disposed in the radial direction when seen from the

circumferential direction,

wherein said tail side coil end includes a plurality of said tail joint portions disposed serially in the radial direction with predetermined gaps, and

5 a radial gap between adjacent tail slanting portions disposed in the radial direction is widened in the vicinity of said tail joint portions compared with a radial gap in the vicinity of an end surface of said stator core.

10 2. The stator coil including sequentially-connected conductor segments for an electric rotary machine in accordance with claim 1, wherein a tilt angle of the tail slanting portion positioned at a radially outer side is larger than a tilt angle of the tail slanting portion positioned at a radially inner side, when said tilt angle is defined as an angle of a line inclined toward the radially outer side with respect to an axis of said stator core.

15 3. The stator coil including sequentially-connected conductor segments for an electric rotary machine in accordance with claim 1, wherein a tilt angle of the tail slanting portion positioned at a radially inner side is larger than a tilt angle of the tail slanting portion positioned at a radially outer side, when said tilt angle is defined as an angle of a line inclined toward the radially inner side 20 with respect to an axis of said stator core.

25 4. The stator coil including sequentially-connected conductor segments for an electric rotary machine in accordance with claim 1, wherein said tail joint portions of said tail conductor portions are aligned on a line normal to the axis of said stator core which is spaced from the end surface of said stator core.

30 5. The stator coil including sequentially-connected conductor segments for an electric rotary machine in accordance with claim 1, wherein said tail conductor portions have identical longitudinal length.

6. The stator coil including sequentially-connected conductor segments for an electric rotary machine in accordance with claim 1, wherein said tail slanting portions are curved or bent so as to secure said radial gap between said tail joint portions of the tail conductor portions.

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7. The stator coil including sequentially-connected conductor segments for an electric rotary machine in accordance with claim 1, wherein

a plurality of conductor segment sets are disposed in the radial direction, each conductor segment set is constituted by a small-turning conductor segment and a large-turning conductor segment, said small-turning conductor segment including a small-turning head portion continuously formed with a pair of said in-slot conductor portions accommodated separately into a pair of said conductor accommodation positions disposed adjacently to each other in the radial direction, and said large-turning conductor segment including a large-turning head portion straddling in the radial direction so as to surround said small-turning head portion,

a group of said conductor segment sets is located at the same radial position and disposed in the circumferential direction to constitute a partial phase coil to which a predetermined phase voltage is applied,

20 said phase coil is constituted by serially connecting a plurality of partial phase coils having different radial positions and disposed sequentially in the radial direction.

8. The stator coil including sequentially-connected conductor segments for an electric rotary machine in accordance with claim 7, wherein

25 an inphase slot group is constituted by a plurality of said slots adjacently and continuously disposed in the circumferential direction for accommodating in-slot conductor portions to which a same inphase voltage is applied,

30 a plurality of serial phase coil circuits are accommodated in different slots of the inphase slot group, each serial phase coil circuit including serially

connected said partial phase coils accommodated in the same slot and disposed sequentially in the radial direction to have different radial positions, and

5       said phase coil is constituted by connecting said plurality of serial phase coil circuits in parallel with each other.

9. A stator coil including sequentially-connected conductor segments for an electric rotary machine, comprising:

10      a plurality of conductor segments accommodated in a slot of a stator core having an even number of conductor accommodation positions serially aligned in the radial direction, said conductor segments being sequentially connected to cooperatively constitute one turn of a phase coil of an M-phase (M is an integer not smaller than 3) armature coil,

15      each of said conductor segments having a pair of in-slot conductor portions separately accommodated into the conductor accommodation positions of two different slots mutually spaced by substantially one pole pitch, a head conductor portion continuously extending from said in-slot conductor portions and protruding from one end of said stator core so as to constitute a head side coil end, and a pair of tail conductor portions continuously 20 extending from said in-slot conductor portions and protruding from the other end of said stator so as to constitute a tail side coil end,

25      said head conductor portion having a U-shaped head top portion, and a pair of head slanting portions extending obliquely in both circumferential and axial directions from said head top portion and respectively connected to said in-slot conductor portions,

30      said tail conductor portions having a pair of tail slanting portions extending obliquely in both circumferential and axial directions from said pair of in-slot conductor portions, and tail joint portions formed at distal ends of said tail slanting portions and bonded to tail conductor portions of other conductor segment,

      said head side coil end including a plurality of said head conductor

portions serially disposed in the radial direction when seen from the circumferential direction, and

5        said tail side coil end including a plurality of said tail conductor portions serially disposed in the radial direction when seen from the circumferential direction,

      wherein said tail side coil end includes a plurality of said tail joint portions of the tail conductor portions disposed serially in the axial direction with predetermined gaps, and

10      said tail slanting portions are curved or bent at their intermediate points spaced from an end surface of said stator core so as to extend in the radial direction.

15      10. The stator coil including sequentially-connected conductor segments for an electric rotary machine in accordance with claim 9, wherein

      a plurality of conductor segment sets are disposed in the radial direction, each conductor segment set is constituted by a small-turning conductor segment and a large-turning conductor segment, said small-turning conductor segment including a small-turning head portion continuously formed with a pair of said in-slot conductor portions accommodated separately into a pair of 20 said conductor accommodation positions disposed adjacently to each other in the radial direction, and said large-turning conductor segment including a large-turning head portion straddling in the radial direction so as to surround said small-turning head portion,

25      a group of said conductor segment sets is located at the same radial position and disposed in the circumferential direction to constitute a partial phase coil to which a predetermined phase voltage is applied,

      said phase coil is constituted by serially connecting a plurality of partial phase coils having different radial positions and disposed sequentially in the radial direction.

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      11. The stator coil including sequentially-connected conductor segments

for an electric rotary machine in accordance with claim 10, wherein

an inphase slot group is constituted by a plurality of said slots adjacently and continuously disposed in the circumferential direction for accommodating in-slot conductor portions to which a same inphase voltage is applied,

a plurality of serial phase coil circuits are accommodated in different slots of the inphase slot group, each serial phase coil circuit including serially connected said partial phase coils accommodated in the same slot and disposed sequentially in the radial direction to have different radial positions,

10 and

said phase coil is constituted by connecting said plurality of serial phase coil circuits in parallel with each other.

12. A method for manufacturing a stator coil including sequentially-connected conductor segments for an electric rotary machine,

said stator coil comprising

a plurality of conductor segments accommodated in a slot of a stator core having an even number of conductor accommodation positions serially aligned in the radial direction, said conductor segments being sequentially connected to cooperatively constitute one turn of a phase coil of an M-phase (M is an integer not smaller than 3) armature coil,

each of said conductor segments having a pair of in-slot conductor portions separately accommodated into the conductor accommodation positions of two different slots mutually spaced by substantially one pole pitch, 25 a head conductor portion continuously extending from said in-slot conductor portions and protruding from one end of said stator core so as to constitute a head side coil end, and a pair of tail conductor portions continuously extending from said in-slot conductor portions and protruding from the other end of said stator so as to constitute a tail side coil end,

30 said head conductor portion having a U-shaped head top portion, and a pair of head slanting portions extending obliquely in both circumferential and

axial directions from said head top portion and respectively connected to said in-slot conductor portions,

5        said tail conductor portions having a pair of tail slanting portions extending obliquely in both circumferential and axial directions from said pair of in-slot conductor portions, and tail joint portions formed at distal ends of said tail slanting portions and bonded to tail conductor portions of other conductor segment,

10      said head side coil end including a plurality of said head conductor portions serially disposed in the radial direction when seen from the circumferential direction, and

      said tail side coil end including a plurality of said tail conductor portions serially disposed in the radial direction when seen from the circumferential direction,

15      wherein said tail side coil end includes a plurality of said tail joint portions disposed serially in the radial direction with predetermined gaps, and

      a radial gap between adjacent tail slanting portions disposed in the radial direction is widened in the vicinity of said tail joint portions compared with a radial gap in the vicinity of an end surface of said stator core, and

20      a tilt angle of the tail slanting portion positioned at a radially outer side is larger than a tilt angle of the tail slanting portion positioned at a radially inner side, when said tilt angle is defined as an angle of a line inclined toward the radially outer side with respect to an axis of said stator core,

      said manufacturing method comprising the step of:

25      separately holding said head top portions of said conductor segments inserted in said slots with a plurality of rings disposed coaxially and rotatable relative to each other,

      expanding said tail slanting portions of said conductor segment in the circumferential direction by rotating said rings,

30      deforming said tail conductor portions to incline toward the radially outer side, and

      welding a pair of said tail joint portions disposed adjacently to each

other in the radial direction.